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TESTIMONY OF

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Mr. Chairman, members of the committee, thank you for the opportunity to appear before you today to provide an update on the progress made by the Department of Defense (DoD) research and engineering program in meeting the recommendations made in the Report of the Commission on the Future of the United States Aerospace Industry; the Walker Commission report. While the report had nine broad recommendations, my testimony shall focus on the progress made by the DoD research and engineering community. Before addressing specific aspects of the report, it is important to point out that aerospace power has been critical to U.S. military operational capabilities almost since the first flight of the Wright Brothers a century ago. Air and space power shall continue to be a critical component of the DoD operational mission. On the occasion of the 100th anniversary of flight last December, President Bush said "A great American journey that began at Kitty Hawk continues in ways unimaginable to the Wright brothers. One small piece of their Flyer traveled far beyond this field. It was carried by another flying machine, on Apollo 11, all the way to the Sea of Tranquility on the Moon. These past hundred years have brought supersonic flights, frequent space travel, the exploration of Mars, and the Voyager One spacecraft, which right now is moving at 39,000 miles per hour toward the outer edge of our solar system. By our skill and daring, America has excelled in every area of aviation and space travel. And our national commitment remains firm: By our skill and daring, we shall continue to lead the world in flight."

As it has in the past, aviation and space capabilities continue to be at the forefront of the DoD goals. In the 2001 Quadrennial Defense Review, Secretary of Defense Donald Rumsfeld listed six critical operational goals for the Department. Aviation and space are central to those goals, and when integrated with the concept of network centric

warfare, will drive our military advantage in a changing world. Together, aviation and space capabilities are critical to enabling all six QDR goals and are key specifically to denying enemy sanctuary, projecting and sustaining U.S. forces, protecting U.S. bases of operation, and conducting space operations.

The Aerospace Commission made recommendations in nine broad areas. Recommendations in four of the areas are directly applicable to the DoD. I shall restate the salient recommendations and briefly discuss activity within the Department that addresses them.

1. Recommendation 3: The Commission recommends that the United States create a space imperative. The DoD, the National Aeronautics and Space Administration and industry must partner in innovative aerospace technologies, especially in the areas of propulsion and power.

Over the past two years, the Director of Defense Research and Engineering has led an interagency initiative that responds directly to the recommendation made by the Commission. This initiative, known as the National Aerospace Initiative (NAI), is a focused effort to coordinate technology development and demonstrations in three key aerospace technology areas. The three technology areas are the pillars of the NAI: high speed and hypersonic flight; space access; and space technologies. The most extensive collaborations have occurred in the high speed and hypersonic technology flight pillar. We appreciate the support provided by the House Armed Services Committee in the NAI related research and development in FY04. The FY04 program started the Single Engine Demonstration (SED). The SED is an advanced prototype hypersonic cruise missile that will integrate the United States Air Force Hypersonic Technology (HyTech) engine with

air vehicle technologies developed by DARPA. The project and technology path are supported by federal and industrial hypersonic researchers and build on previous DoD-NASA efforts.. This exciting new demonstration will be flight tested by the end of the decade, will represent the world's first demonstration of a practical flight vehicle propelled by a hydrocarbon supersonic combustion ramjet (scramjet), and should ultimately achieve a Mach 7 to 8 flight. This is a significant effort; success will enable a new aviation flight regime, historically analogous to the revolutionary introduction of the jet engine to propeller-driven aircraft.

The second area of significant collaboration is in the area of advanced rocket propulsion. A key element under the NAI in the joint NASA-Air Force program is called the "Integrated Powerhead Demonstration" (IPD), which will culminate with a complete engine test at NASA's Stennis Space Center in 2005. This demonstration has been a very successful partnership between the United States Air Force and NASA, with four successful component demonstrations occurring in the past 18 months. This is yet another significant effort because the success of this new engine cycle will enable a 25% increase in rocket engine reliability, a 200-mission life for the engine, and a reduction in engine maintenance time and cost. DoD-NASA cooperation leading to the IPD should result in future reusable vehicle propulsion and will overcome current material technology barriers by reducing engine operation temperatures

Finally, it is important to acknowledge that the NAI also includes continuation of successful long term collaboration in the form of the Integrated High Performance Turbine Engine Technology (IHPTET) / Versatile Affordable Advanced Turbine Engines (VAATE) projects. IHPTET is a program that started in the late 1980's, and involved

collaboration of DoD, NASA, and industry to have a long-term, focused research program to improve turbine engine technology. IHPTET is currently developing the revolutionary turbine accelerator, which will allow turbine propelled vehicles to reach hypersonic ignition speeds. This turbine engine technology is an essential part of and boost to the health of the national aircraft industry.

There are other federal interactions and collaborations that will support Recommendation 3. An example is the Joint Planning Development Office, which is a federal collaboration between the DoD, NASA, Federal Aviation Administration (FAA) and Department of Homeland Security (DHS). This collaboration is working to create the next generation air management system.

Through rapid advancement in aerospace capabilities, the NAI and other collaborative efforts will effectively merge air and space, spur innovation in critical high technology areas, and reinvigorate the U.S. aerospace industry, as well as excite and inspire our Nation's next-generation high-technology science and engineering workforce. While there is a great deal of promise, it is important to point out that these plans are being reviewed and modified, as NASA is adjusting their portfolio and priorities following the Columbia disaster. But, even without concrete flight demonstrations, the NAI is significant for necessary technology development and organization.

As part of the process of organizing the NAI, the DoD and NASA have organized a joint project office, with technologists from both NASA and the DoD working out of one location on similar goals. These technologists are coordinating on-going programs at the sub-component technology level, leading to very strong information and technology

sharing. While there is still much to do, there have been significant accomplishments over the past two years.

2. *Recommendation 4: The Commission recommends that the nation adopt a policy that invigorates and sustains the aerospace industrial base. This policy must include*

a. *Procurement policies which include prototyping, spiral development, and other techniques which allow the continuous exercise of design and production skills;*
b. *Stable funding for core capabilities, and*
c. *Sustaining critical technologies that are not likely to be sustained by the commercial sector.*

Portions of this recommendation are well beyond the purview of the DoD science and technology program; however, the Department has made some substantive changes in technology programmatics and acquisition policy over the past two years that address the theme of prototyping, spiral development, and technology insertion. In the past two years, the DoD has issued revised acquisition regulations that encourage and promote spiral development and incremental technology insertion. In addition, the Department has made programmatic changes to encourage a "try before you buy" approach to acquisition. In November 2003, the Department revised the charter of the Director of Defense Research and Engineering, to make the DDR&E responsible for a broader swath of the acquisition process, adding the responsibilities for "Advanced Component Development and Prototyping" to the existing DDR&E portfolio. These actions should result in greater prototyping before moving into specific acquisition programs of record.

The DoD is also increasing investment in technology demonstrations. Over the past several years, the Advanced Concept Technology Demonstration (ACTD) Program has grown significantly. ACTDs are demonstrations of technology moving from the science and technology world to the acquisition world. For example, the Predator Unmanned Aerial Vehicle (UAV) emerged from the ACTD program several years ago. Over the past three years, ACTDs have grown by over 25% to the present budget request of $213M in FY05. Since ACTD projects are typically matched with about three dollars from the sponsor command for every one dollar invested by the ACTD program office, the total program value is actually closer to $800M per year. While these funds are spread over many different projects, some are invested in efforts that directly address the aerospace industry. For instance, the ACTD program is actively developing a High Altitude Airship, which is akin to a stratospheric dirigible. This platform will maintain position in the stratosphere for several months. This technology will open up new reconnaissance and surveillance possibilities. Another ACTD of aerospace significance is the "Advanced Tactical Laser" ACTD, which will attempt to marry a high energy laser with an AC-130 gunship. While not specifically an advanced aerospace technology application, this ACTD should provide a broad new aerospace mission area.

3. Recommendation 8: The Commission recommends the nation immediately reverse the decline in, and promote the growth of, a scientifically and technologically trained U.S. aerospace workforce. In addition, the nation must address the failure of the math, science, and technology education of Americans. The breakdown of America's

intellectual and industrial capacity is a threat to national security and our capability to continue as a world leader.

Clearly, the Commission was concerned with the decline in production of U. S. scientist and engineers. This concern is also shared by the Department of Defense Chief Technology Officer, the Director of Defense Research and Engineering. The following excerpt is taken directly from a DDR&E testimony given on March 3, 2004.[1]

"There are warnings that America's advantage in defense-related scientific and engineering intellectual capital is eroding. For example, the significance and priority of this problem was (also) outlined in the "Report of the U. S. Commission on National Security in the 21st Century (the Hart-Rudman Report) which stated: *Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter of a century.*

The decreasing numbers of experienced, expert scientists and engineers available for National Security efforts come from the available pool of scientists and engineers who are U. S. citizens. The number of those U. S. citizens in graduate schools in defense and national security related disciplines has been decreasing for the last decade, according to National Science Foundation, National Science Board, and National Academy of Sciences Reports."

This excerpt from the DDR&E testimony becomes even more significant when two additional factors are considered: the growth in S&E production in the rest of the world, and the dependence on DoD funding for U.S. universities research in several significant technology areas. The first factor, production of S&Es worldwide, is

[1] Formally, it was given to the Senate Armed Services Committee hearing on 3 March 2004

something that the DoD and the entire national security community needs to pay attention to. For instance, China has experienced an exponential growth in domestically produced scientists and engineers over the past 5-10 years. There is evidence that they now produce the largest number of scientists and engineers in the world. In addition, citations in some U.S. based journals, such as Physics Review, have increasingly seen an increase in the number of published papers by foreign authors. Growth in intellectual knowledge worldwide is a good thing—provided the United States continues to produce world class S&E's to allow our nation to meet any challenge.

The second relevant factor is slightly more subtle. According to annual statistics published by the National Science Foundation, there are a number of physical science areas where the DoD provides between one-third and one-half of all government funded university research dollars. These areas include: aeronautical engineering, mechanical engineering, electrical engineering, materials science, and computer science. In short, the scientific core of the aerospace sciences. This issue is one that affects the entire national security infrastructure, and is being looked at by the National Security Subcommittee of the Committee on Homeland and National Security under the National Science and Technology Council.

Taken as a whole, the picture is of concern—U. S. production of S&Es as a whole is declining, while the production of S&E's in the rest of world is growing. To combat this trend, we believe at least two things must happen—there should be sufficiently exciting projects to spark the interest of young minds, and there should be sufficient funds to provide incentive for a young person to enter a scientific field. In the DoD, and in NASA, there are cutting-edge projects to attract young researchers. Projects such as

the single engine demonstration and the Army hydrogen-based missile demonstration should achieve Mach 7 and 12 respectively. The Force Application and Launch from CONUS (FALCON) hypersonic vehicle, a DARPA project, will develop a reusable hypersonic aircraft capable of delivering 12,000 pounds of payload to a target 9,000 nautical miles from the continental U.S. in less than two hours. These *are* truly interesting projects!

Over the past year, the DoD has increased both the total number of and annual stipend for Graduate Science and Engineering Fellowship programs. Hence, the DoD is beginning to provide financial incentive. We are continuing to examine our future workforce needs to ensure that we will have the best technical talent available for national security R&D.

4. Recommendation 9: The Commission recommends that the federal government significantly increase its investment in basic aerospace research, which enhances US national security, enables breakthrough capabilities, and fosters an efficient, secure and safe aerospace transportation systems. The U. S. aerospace industry should take a leading role in applying research to product development.

The Department of Defense has increased both the investment and focus of research in aerospace areas over the past three years. In fact, the two technology areas with the largest funding increases have been aerospace and combating the global war on terrorism. The Department of Defense tracks the raw investment in specific technology areas through the Defense Technology Area Plan (DTAP), which aligns technologies and investments. Comparison of the science and technology investment in the Air Platforms

and Space Platforms technologies between the FY2002 and FY2005 Budget Request shows the following trend:

	FY2002	FY2005	Percent increase since FY02
Air Platforms	$443,921M	$691,889M	56%
Space Platforms	$176,646M	$380,112M	115%

But, the Commission report also recommended an increased investment in long-term aerospace research in the following areas: Information Technology; Propulsion and Power; Noise and Emissions; Breakthrough Energy Sources; Human Factors; and Nanotechnology. Investment into the science and technology base for all these areas is increasing in the Department of Defense. Additionally, the DoD has increased investment and work in modeling and simulation of flight profiles and computational fluid dynamic codes for engines, airframes, and now, hypersonic combustion. The Department has also focused a science and technology effort, called “Energy and Power Technologies” which has goals of increasing energy density from materials and batteries and increasing the energy efficiency of solar collectors in space.

Clearly, the investment has, in fact, increased. But, more important than the basic investment is the content of the program. Consider the additional following significant technology activities that have occurred over the past several years:

- The Integrated High Performance Turbine Engine Technology (IHPTET) program has increased the operating parameters of the turbine engine to support the next generation turbine engines for military and (spin-off) civil applications, effectively

doubling capability, including increased thrust-to-weight and decreased specific fuel consumption (SFC), since the program's inception.

- The Versatile Affordable Advanced Turbine Engine Program (VAATE) follows on from IHPTET and is specifically focused on affordability and manufacture of the follow on turbine engines. The goal is to achieve an order of magnitude improvement in turbine engine affordability.

- The Navy Hypersonic Flight (HyFly) and Revolutionary Approach to Time Critical Long Range Strike (RATTLRS) programs, which will fly a Mach 6, dual-combustion ramjet and Mach 4 turbine for missile applications.

- Integrated High Payoff Rocket Propulsion Technology Program (IHPRPT), a joint DoD / NASA / U.S. industry effort, has increased the performance, life, reliability and affordability of solid rocket motors, liquid engines and electric propulsion for space launch, on-orbit and strategic and tactical missile systems.

- The DARPA FALCON program, which will develop and demonstrate the basics of controlled hypersonic flight at stratospheric altitude.

- The DARPA / Army A-160 Hummingbird unmanned helicopter demonstration—a program which will provide the advantages of hover and helicopter operations in an unmanned vehicle

- The new DARPA, Navy, and Air Force Joint Unmanned Combat Aviation System (J-UCAS)—a family of platforms to conduct future combat air operations in unmanned platforms.

The list could be much longer. It is not important to list the all the specific programs, but rather, to characterize the current DoD research and engineering program

as one of great growth and exciting possibilities for both air and space capabilities. The Department is opening new regimes of speed, autonomous operations, power, and air frames needed to move forward, with industry, into the next golden age of flight.

SUMMARY

This testimony has addressed the role of the DoD research and engineering program in responding to the recommendations of the Walker Aerospace Commission report. The report has a recommendation that is appropriate to use for the summary. Recommendation 1 of the report says "The integral role aerospace plays in our economy, our security, our mobility, and our values makes the global leadership in aviation a national imperative. Given the real and evolving challenges that confront our nation, government must commit to increased and sustained investment and must facilitate private investment in our national aerospace sector. The Commission therefore recommends that the United States boldly pioneer new frontiers in aerospace technology, commerce, and exploration."

I have attempted to demonstrate that the overall DoD research and engineering program does respond to the Commission report, because aviation and aerospace are central to the future military operations of the Department. Aerospace research and systems have been, and will continue to be, at the forefront of the DoD's needs. The growth in funding and focus of the Department's S&T investment in aerospace areas demonstrate the importance of the aerospace industry to the DoD.